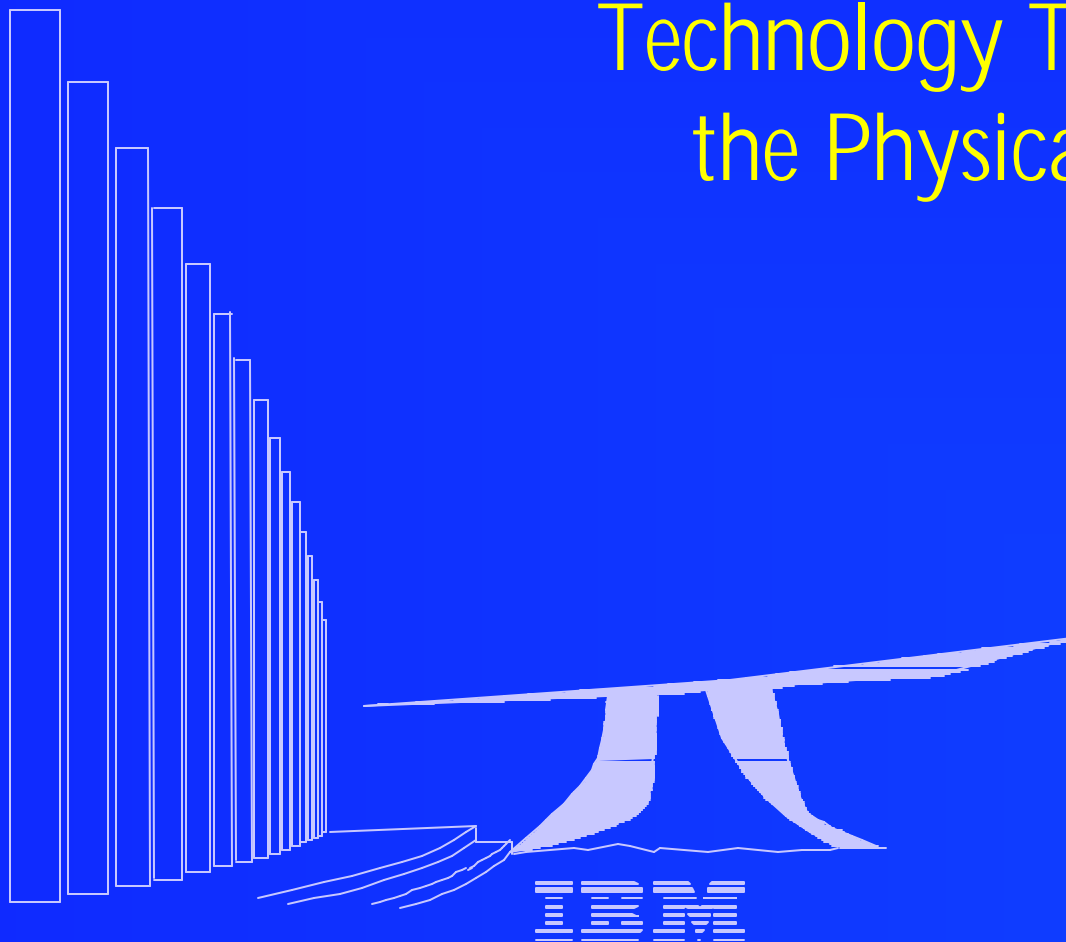# Technology Trends in Connecting the Physical and Digital Worlds
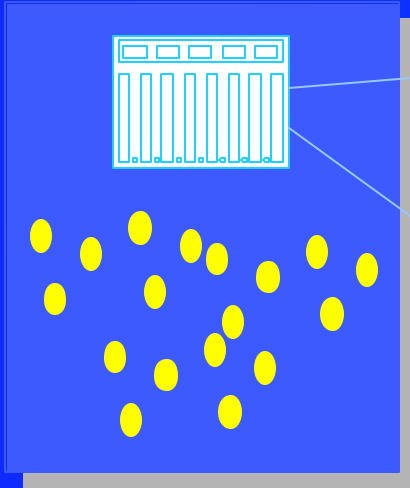
Paul B. Chou, Marisa Viveros
Pervasive Computing Solutions
IBM Thomas J. Watson Research Center
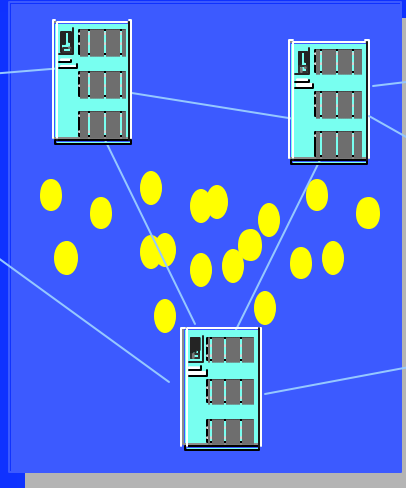
IBM Research worldwide

Almaden

Watson

Zurich

Beijing

Austin

Haifa

Delhi

Tokyo

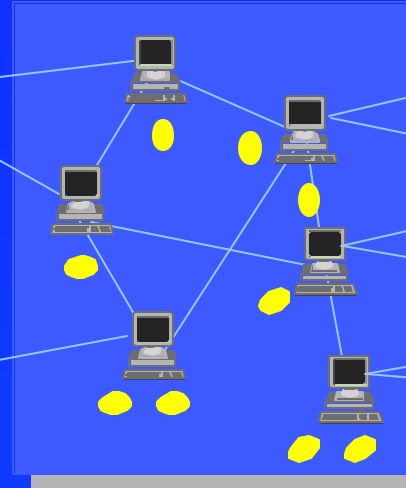# Technology has changed things around
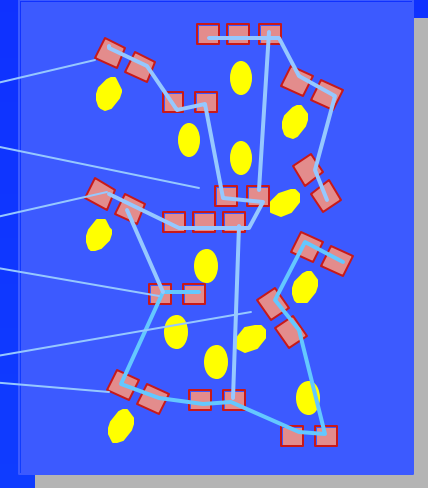
Many persons, one computer

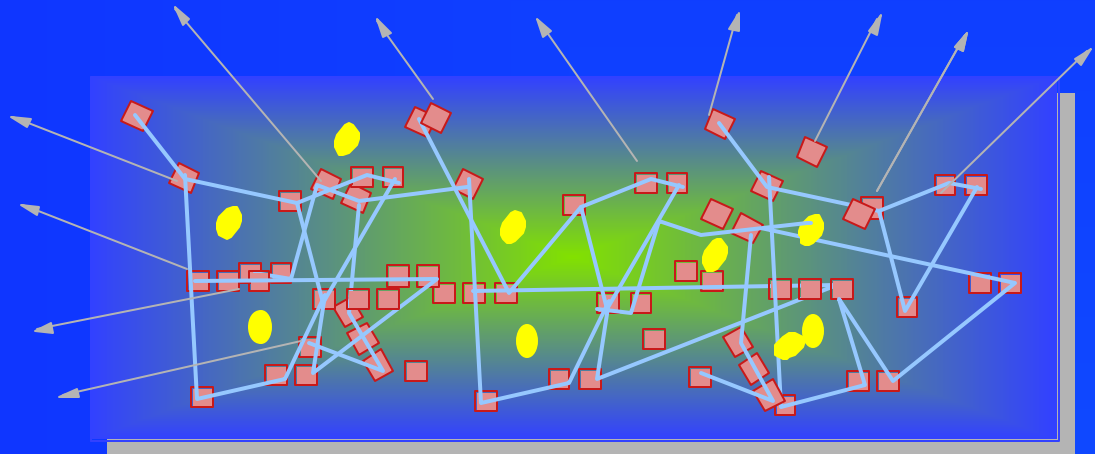**Fewer persons per computer**

One person per computer

One person, few computers

One person, many computers!!!

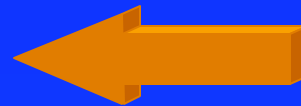People, appliances. Locally, remotely. Fixed, mobile. Wired, wireless

Sample scenarios of this new world

- "Smart" interacting devices
  - At home
    - alarm clock activates coffee maker
    - refrigerator detects shortage of food and orders replenishment
    - microwave recognizes food type and prepares accordingly
  - On the road
    - cars "negotiate" right of way in traffic congestion
    - car reports malfunction and request road assistance
  - At the office
    - environment automatically adjusts to individual preferences
- But there are sociological issues to take into account
  - Privacy considerations
  - "I don't want to reorder the same wine all the time"
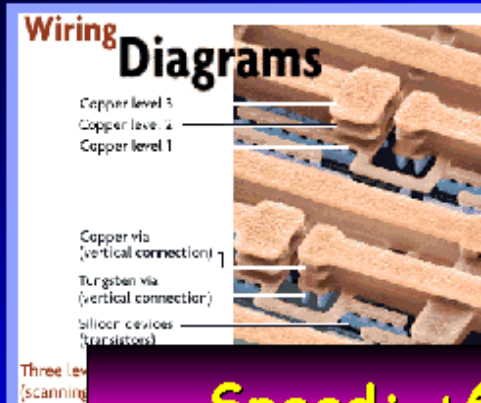 - ....

Trends and challenges

- Technology goes faster and smaller

- Everything goes online

- New sensing capabilities

- Utility-like infrastructure

- Software building blocks become the business
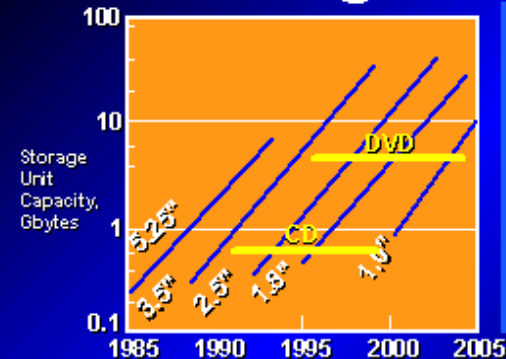
- Optimize to survive

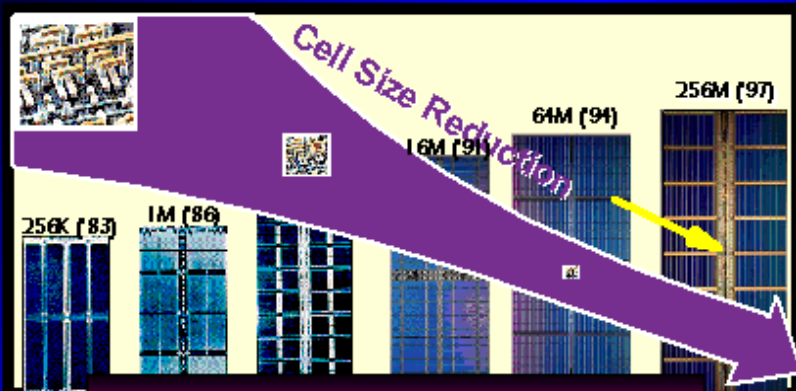# Trend 1: Technology goes faster and smaller

CPU (Cu, 1GHz)

Wiring **Diagrams**
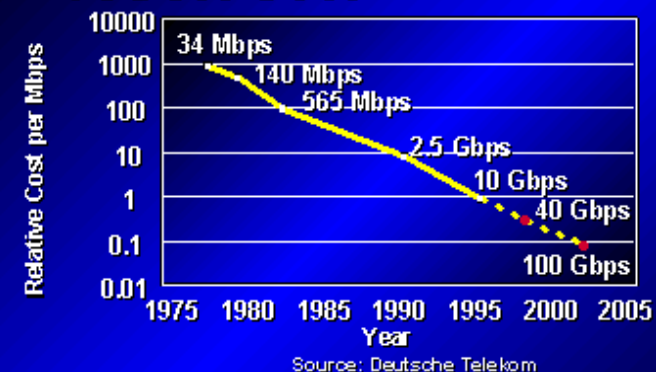
Copper level 3
Copper level 2
Copper level 1

Copper via
(vertical connection)

Tungsten via
(vertical connection)

Silicon devices
(transistors)

Three le
(scanning

1000 MHz 64-bit
Integer Processor

IBM

Speed: +69%

Storage

Storage
Unit
Capacity,
Gbytes

DVD

CD

5.25"
3.5" 2.5" 1.8" 1.0"

Density: +65%

DRAM Evolution

Cell Size Reduction

256M (97)
64M (94)
16M (91)
1M (86)
256K (83)

Bits/Chip: +59%

Network

Relative Cost per Mbps

34 Mbps
140 Mbps
565 Mbps
2.5 Gbps
10 Gbps
40 Gbps
100 Gbps

Year

Source: Deutsche Telekom

Speed: +151%

Trend 2: Everything goes online

- Connected computation everywhere will rapidly change the interaction of people and objects with the digital world

- Pervasive devices become the dominant means of information access (aka "ubiquitous" devices)

The "pervasive computing" generation

"Locality-aware"

"Always-on" mobile

"Environment-aware"

. . .

Trend 3: Innovations/progress on sensors

- Dramatic evolution of some sensors
  - speech recognition, GPS, ...

- New generation of sensor technology
  - users "emotion" or "attention"
  - ...

- New applications exploiting such sensors

Natural user identification

Speech

Fingerprint
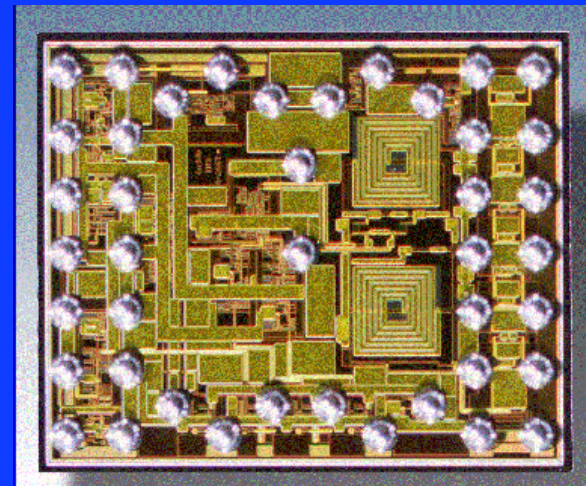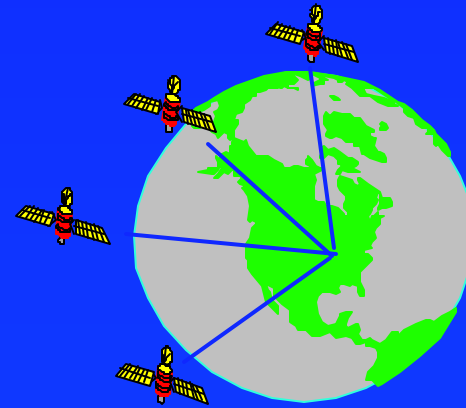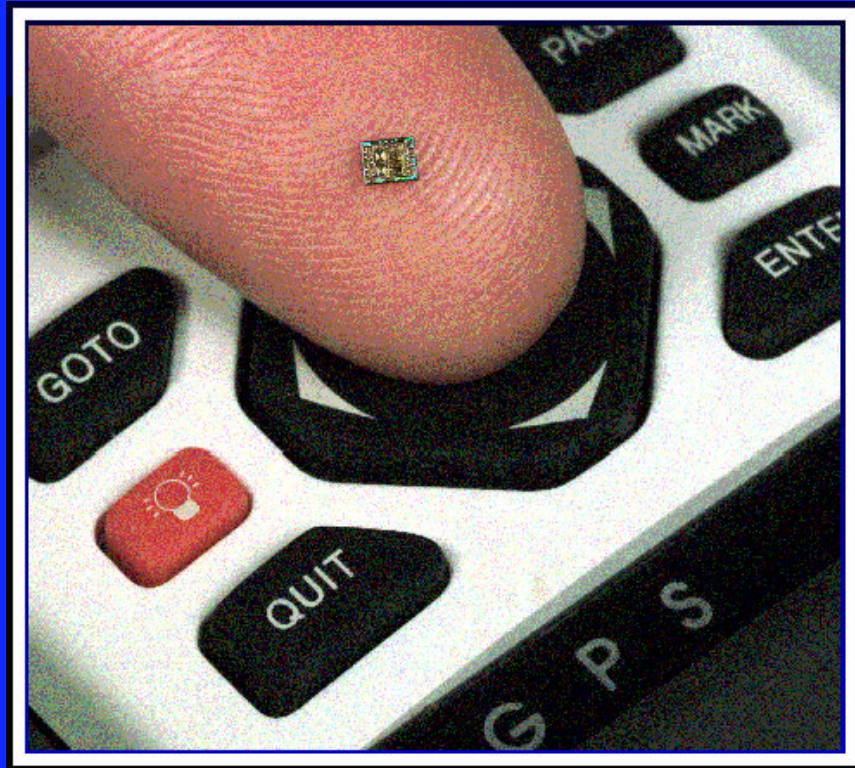

Handwriting

Face

Eye

Hand Geometry

Enhance Security for Network Applications
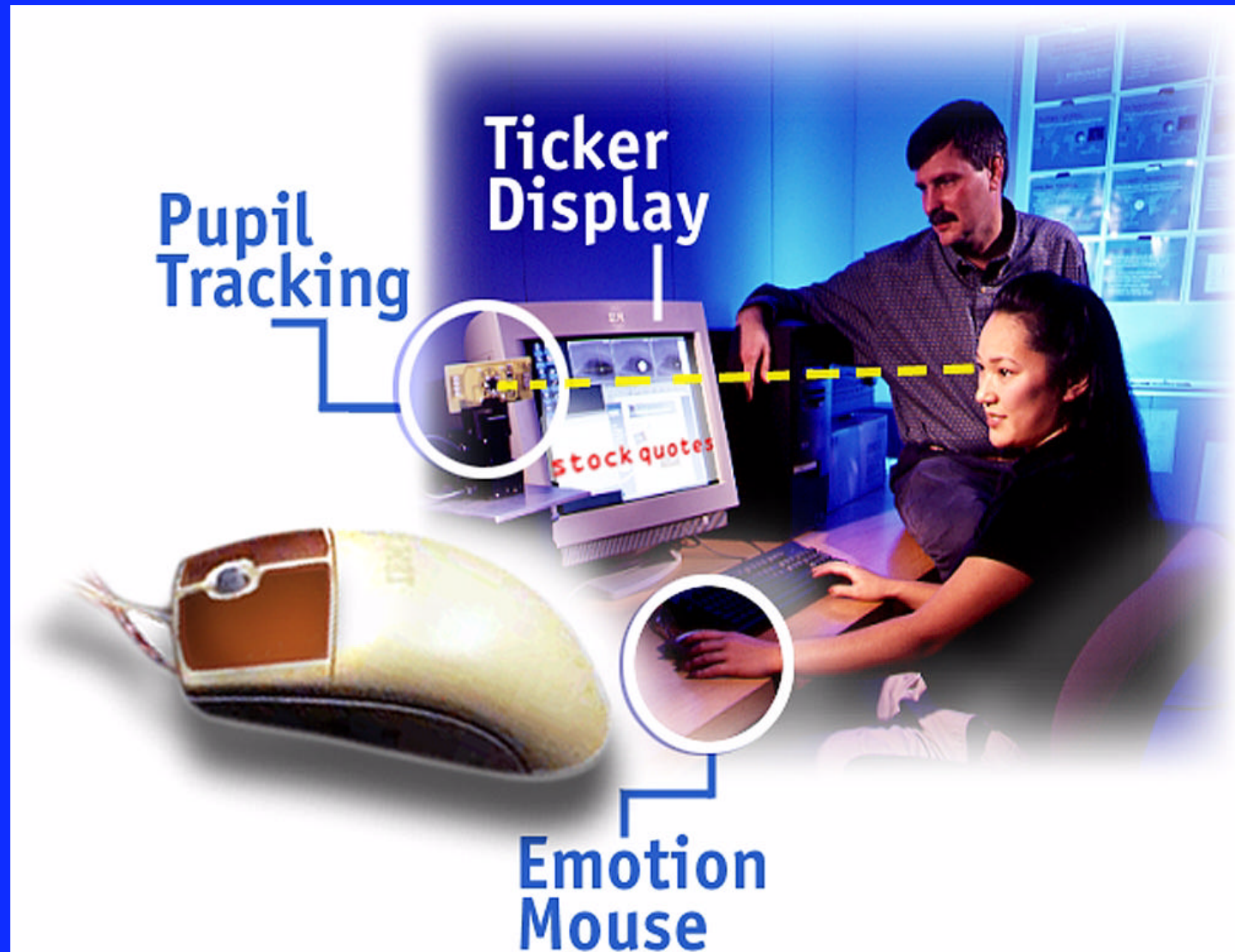
Applications for Banking, Insurance, Healthcare, Travel, Retail, ...

Direct-to-Digital GPS receiver
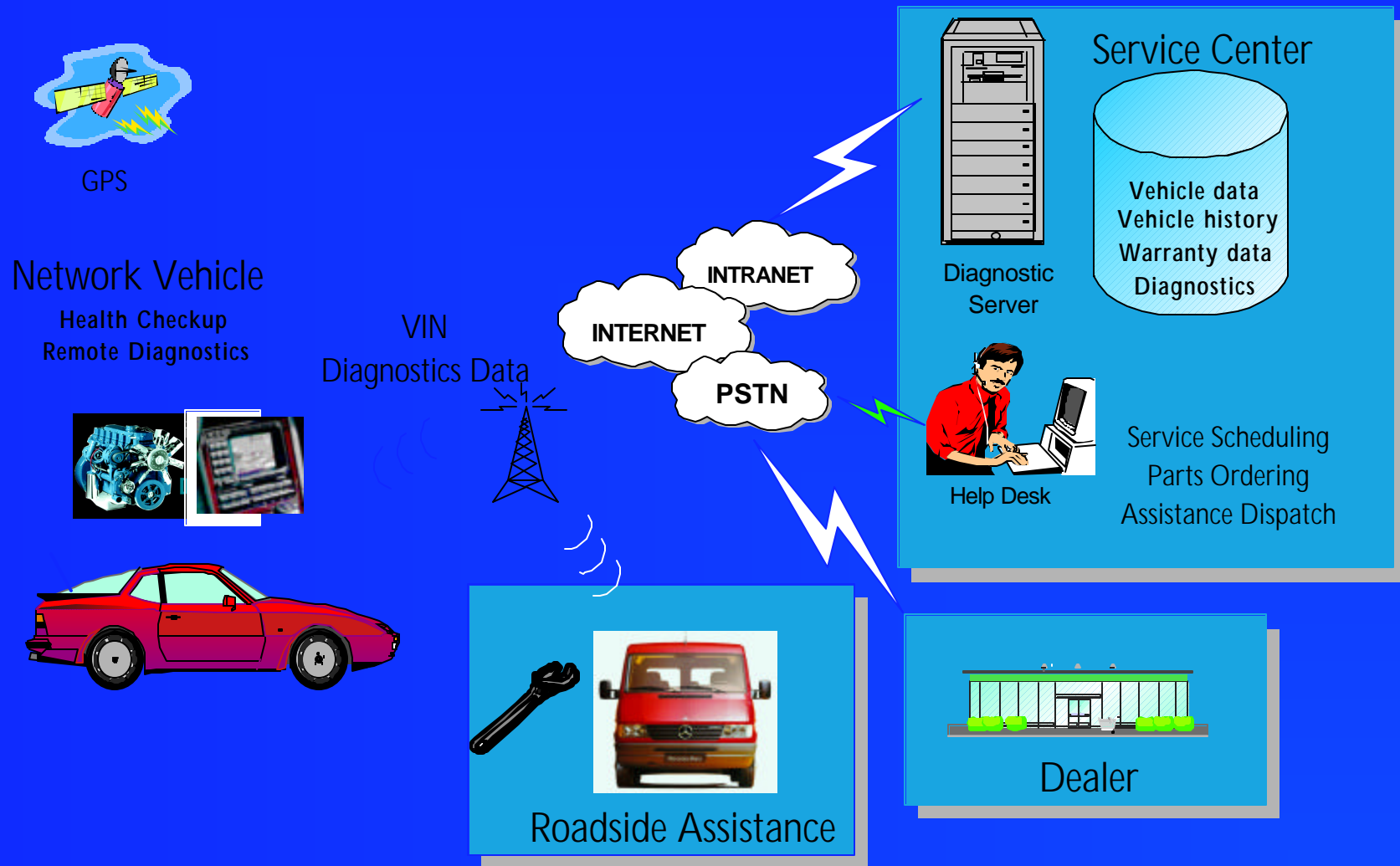

Complete digital radio chip

Attentive environments

Some challenges we are addressing

- Ever smaller, ever "smarter" appliances

- Integration of the technology in "real-life" applications

- Creating the infrastructure that makes possible the realization of such applications

Automotive Solutions

GPS

Network Vehicle

Health Checkup
Remote Diagnostics

VIN
Diagnostics Data

INTRANET

INTERNET

PSTN

Service Center

Diagnostic
Server

Vehicle data
Vehicle history
Warranty data
Diagnostics

Help Desk

Service Scheduling
Parts Ordering
Assistance Dispatch

Roadside Assistance

Dealer

e-Commerce: Pervasive Shopping

Consumer

SPT 1500 w/ modem

Network PSTN or Cellular

Information System

PdaProxy Server

Remote Shopping Server

- ProfileServer
- Promotions system
- Order list system
- Data management
- Data mining
- Logging

Safeway Stores

publish orders via intranet

- Process orders

pickup/delivery

- Personalized Shopping list
- Promotions derived upon data analysis using data mining techniques
- Input data using bar-code scanner
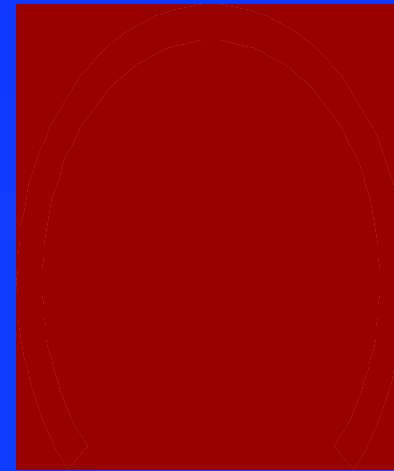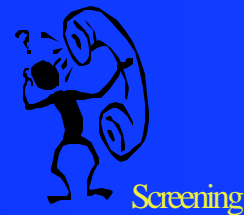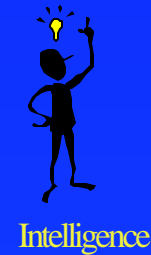- Ease-of-use interface

Conversational User Interfaces

- **Virtual Assistant**
  - Summarization
  - Awareness
- **Unified Messaging**
  - Voicemail as e-mail attachments
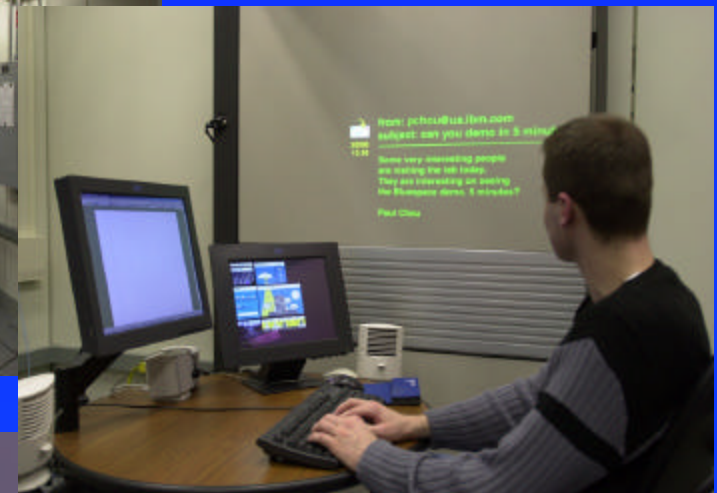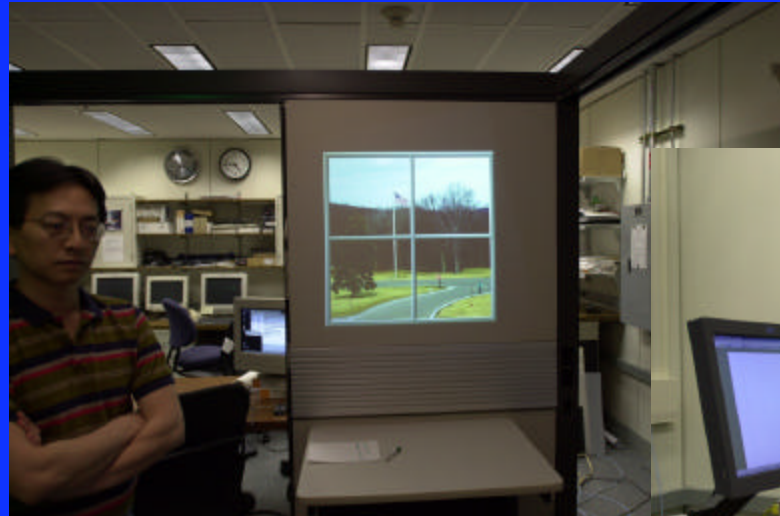 - Access to calendar, mail, To do
  - Fax access
  - Name dialing

Prioritization

Intelligence

Calendaring

Urgent Messages

Research

Screening

Categorization

BlueSpace

Creating a personalized, context aware workspace

Everywhere Displays

Turning physical surfaces into interactive displays

Wearable PC

Highlights

ThinkPad 560X Equivalent High Spec
- Full Function Portable PC Logic,
- IBM High Density Packaging

Ultimate Portability
- Headphone Stereo Size System Unit
- 2/3lbs (299g)

IBM MicroDrive
- 1" Disk, 5mm Thick,
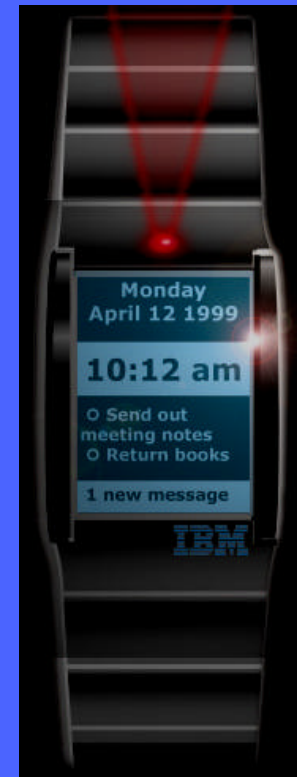- 20g, 340MB Capacity

Transparent Head Mount Display
- Invented by IBM T.J. Watson
  Research

WatchPad

- Billions of watches

- Wearable
  - always on you

- Easy access

- Touch controls

- Wireless companion

- Access
  - Schedule
  - Directions
  - Personal Information

Final observations

- Exciting things are happening

- Major changes are taking place - a new revolution

- A world of interconnected appliances is emerging

- Much research and development still needed

- Most importantly....

We are all
participanting
in it.....!!!